

WHAT IS CLAIMED IS:

1. A device comprising:
 - (a) a solid component and
 - (b) a liquid composition interfaced therewith, said liquid composition
 - 5 having a refractive-index that is substantially equal to that of said solid component, said liquid composition being selected from the group consisting of:
 - (i) saturated cyclic compounds consisting essentially of carbon and hydrogen and optionally oxygen,
 - (ii) benzene substituted with one or more electron-donating
 - 10 groups attached directly to the ring and one of more fluoro groups attached to the ring or to the electron-donating groups, and
 - (iii) a combination comprising one or more of benzene or substituted benzene and optionally at least one of an alkane or substituted alkane having a boiling point less than about 130°C.
- 15 2. A device according to claim 1 wherein said liquid composition is a saturated cyclic compound comprising one or two rings, each have at least four atoms in the ring.
- 20 3. A device according to claim 1 wherein said liquid composition is benzene substituted with one or more electron-donating groups attached directly to the ring and one of more fluoro groups attached to the ring or to the electron-donating groups wherein said electron-donating groups are selected
 - 25 from the group consisting of alkyl, alkoxy, hydroxy, and amino (with the proviso that the compound be liquid).
4. A device according to claim 1 wherein the weight percent of benzene or substituted benzene in said combination is about 30% to about 90%.
 - 30 5. A device according to claim 1 wherein said alkane is substituted with an hydroxy group, an oxo group, a keto group, or an alkoxy group.

6. A device comprising the device of claim 1 wherein said device comprises a groove in a substrate.

7. An optical system comprising:

5 (a) a solid component comprising a cavity and an optical path comprising first and second segments separated by said cavity;

(b) a liquid composition for enhancing optical coupling between said first and second segments, said liquid composition having a refractive-index that is substantially equal to that of said solid component, said liquid composition
10 being selected from the group consisting of:

(i) saturated cyclic compounds consisting essentially of carbon and hydrogen and optionally oxygen,

(ii) benzene substituted with one or more electron-donating groups attached directly to the ring and one or more fluoro groups attached to
15 the ring or to the electron-donating groups, and

(iii) a combination comprising one or more of benzene or substituted benzene and optionally at least one of an alkane or substituted alkane having a boiling point less than about 130°C, and

(c) control means for selectively causing said liquid composition to be
20 disposed in said cavity between said first and second segments.

8. An optical system according to claim 7 wherein said liquid composition is a saturated cyclic compound comprising one or two rings.

25 9. An optical system according to claim 8 wherein said ring or rings each have at least four atoms in the ring.

10. An optical system according to claim 7 wherein said liquid composition is a saturated cyclic compound having no substituents.

30

11. An optical system according to claim 7 wherein said liquid composition is a saturated cyclic compound substituted with one or more alkyl substituents.

5 12. An optical system according to claim 7 wherein said liquid composition is a saturated cyclic compound that is a cyclic alkane, alcohol or ketone.

10 13. An optical system according to claim 7 wherein said liquid composition is a saturated cyclic compound with a refractive index of about 1.44 to about 1.475 at 586.26 nm and a melting point below about 30°C.

15 14. An optical system according to claim 7 wherein said liquid composition is a saturated cyclic compound comprising two rings that are fused.

15 15. An optical system according to claim 7 wherein said liquid composition is a saturated cyclic compound comprising two rings that are spiro.

20 16. An optical system according to claim 7 wherein said liquid composition is a saturated cyclic compound comprising one or two rings wherein each ring independently comprises from 4 to 12 carbon atoms in the ring.

25 17. An optical system according to claim 7 wherein said liquid composition is a cycloalkane that is unsubstituted or substituted with alkyl, cycloalkyl, hydroxy, keto, alkyl or cycloalkyl substituted with hydroxy or keto, fused cycloalkyl, fused cycloalkyl substituted with hydroxy or keto, spiro cycloalkyl, spiro cycloalkyl substituted with hydroxy or keto.

30 18. An optical system according to claim 7 wherein said liquid composition is selected from the group of compounds of Table 1.

10010810-111301

19. An optical system according to claim 7 wherein said liquid composition is benzene substituted with one or more electron-donating groups attached directly to the ring and one of more fluoro groups attached to the ring or to the electron-donating groups wherein said electron-donating groups are
5 selected from the group consisting of alkyl, alkoxy, hydroxy, and amino (with the proviso that the compound be liquid).

20. An optical system according to claim 7 wherein said liquid composition is benzene substituted with one or more electron-donating groups
10 attached directly to the ring and one of more fluoro groups attached to the ring or to the electron-donating groups.

21. An optical system according to claim 7 wherein said liquid composition is selected from the group of compounds of Table 2.
15

22. An optical system according to claim 7 wherein the weight percent of benzene or substituted benzene in said combination is about 30% to about 90%.

20 23. An optical system according to claim 7 wherein said benzene of said combination is substituted with one or more alkyl groups, fluoro groups, fluoroalkyl groups, or alkoxy groups.

24. An optical system according to claim 23 wherein said alkyl groups
25 comprise about 1 to about 20 carbon atoms.

25. An optical system according to claim 7 wherein said alkane of said combination is straight chain, branched chain, or cyclic or a combination thereof.

30 26. An optical system according to claim 25 wherein said alkane is substituted with a hydroxy group, an oxo group, a keto group, or an alkoxy group.

27. An optical system according to claim 25 wherein said alkane comprises about 1 to about 30 carbon atoms.

28. An optical system according to claim 7 wherein said substituted
5 benzene is selected from the group consisting of toluene, xylene, ethylbenzene, diethylbenzene, propylbenzene, and dipropylbenzene, and fluorinated derivatives thereof.

29. An optical system according to claim 28 wherein said fluorinated
10 derivatives thereof are selected from the group consisting of fluorobenzene, difluorobenzene, trifluorobenzene, tetrafluorobenzene, pentafluorobenzene, hexafluorobenzene, fluorotoluene, difluorotoluene, trifluoromethyltoluene, tetrafluorotoluene, and pentafluorotoluene.

30. An optical system according to claim 7 wherein said alkane or
15 substituted alkane of said combination is selected from the group consisting of cyclohexane, cyclopentane, hexane, pentane, butane, propane, neopentane, methylbutane, methylpropane, methanol, ethanol, 2-propanol, 1-propanol, 2-butanol, 2-methyl-2-propanol, 2-methyl-1-propanol, acetone, butanone,
20 cyclohexanone and cyclopentanone.

31. An optical system according to claim 7 wherein said solid component comprises silica.

25 32. An optical system according to claim 7 wherein said solid component is a substrate comprising a groove, said substrate being a component of an optical switch.

33. A method of preparing a liquid composition having a predetermined refractive index at a predetermined temperature, said method comprising combining a first reagent having a refractive index that is higher than said predetermined refractive index at said predetermined temperature and a

10010810-11301

252/5ds
P.T.
30-48

boiling point that is less than about 100 °C with a second reagent having a refractive index that is lower than the refractive index of said first reagent and a boiling point of less than about 130°C wherein said first reagent and said second reagent are combined in amounts effective to obtain said liquid composition having a predetermined refractive index.

34. A method according to claim 33 wherein said liquid composition comprises a third reagent having a refractive index and a boiling point in an amount sufficient to obtain said liquid composition having a predetermined refractive index.

35. A method according to claim 33 wherein said first reagent is present in a weight percent of about 30% to about 90%.

36. A method according to claim 33 wherein said first reagent is benzene or substituted benzene.

37. A method according to claim 36 wherein said benzene is substituted with one or more alkyl groups, fluoro groups, fluoroalkyl groups, alkoxy groups, or hydroxy groups.

38. A method according to claim 37 wherein said alkyl groups comprise about 1 to about 20 carbon atoms.

39. A method according to claim 36 wherein said substituted benzene is selected from the group consisting of toluene, xylene, ethylbenzene, diethylbenzene, propylbenzene, and dipropylbenzene, and fluorinated derivatives thereof.

40. A method according to claim 39 wherein said fluorinated derivatives thereof are selected from the group consisting of fluorobenzene, difluorobenzene, trifluorobenzene, tetrafluorobenzene, pentafluorobenzene,

hexafluorobenzene, fluorotoluene, difluorotoluene, trifluoromethyltoluene, tetrafluorotoluene, and pentafluorotoluene.

41. A method according to claim 33 wherein said second reagent is
5 benzene, substituted benzene, an alkane or substituted alkane having a boiling
point less than about 130°C.

42. A method according to claim 41 of said alkane is straight chain,
10 branched chain, or cyclic or a combination thereof.

43. A method according to claim 41 wherein said alkane is substituted
with an hydroxy group, an oxo group, a keto group, or alkoxy group.

44. A method according to claim 41 wherein said alkane comprises
15 about 1 to about 30 carbon atoms.

45. A method according to claim 41 wherein said alkane or substituted
alkane of said combination is selected from the group consisting of
cyclohexane, cyclopentane, hexane, pentane, butane, propane, neopentane,
20 methylbutane, methylpropane, methanol, ethanol, 2-propanol, 1-propanol, 2-
butanol, 2-methyl-2-propanol, 2-methyl-1-propanol, acetone, butanone,
cyclohexanone and cyclopentanone.

46. A method according to claim 33 wherein said predetermined
25 refractive index is that of a solid component of an optical system.

47. A method according to claim 33 wherein said predetermined
refractive index is that of a silica component of an optical system.

48. A method according to claim 46 wherein said solid component is a
30 solid substrate of an optical switch.

49. An optical switch comprising:

(a) optical waveguides that are formed in a substrate and intersect each other,

(b) a cavity having a wall surface at a predetermined angle from the optical axis of the optical waveguide and positioned at the intersection of the optical waveguides, and

(c) a refractive index-matching liquid disposed for selective introduction into said cavity wherein the refractive index-matching liquid is selected from the group consisting of:

(i) saturated cyclic compounds consisting essentially of carbon and hydrogen and optionally oxygen,

(ii) benzene substituted with one or more electron-donating groups attached directly to the ring and one or more fluoro groups attached to the ring or to the electron-donating groups, and

(iii) a combination comprising one or more of benzene or substituted benzene and optionally at least one of an alkane or substituted alkane having a boiling point less than about 130°C.

50. An optical switch according to claim 49 wherein said liquid is a saturated cyclic compound comprising one or two rings, wherein each ring independently comprises from 4 to 12 carbon atoms, said saturated cyclic compound being unsubstituted or substituted with one or more alkyl substituents.

51. An optical switch according to claim 49 wherein said liquid is a saturated cyclic compound that is a cyclic alkane, alcohol or ketone.

52. An optical switch according to claim 49 wherein said liquid is a cycloalkane that is unsubstituted or substituted with alkyl, cycloalkyl, hydroxy, keto, alkyl or cycloalkyl substituted with hydroxy or keto, fused cycloalkyl, fused cycloalkyl substituted with hydroxy or keto, spiro cycloalkyl, spiro cycloalkyl substituted with hydroxy or keto.

53. An optical switch according to claim 49 wherein said liquid is selected from the group of compounds of Table 1.

5 54. An optical switch according to claim 49 wherein said liquid is
benzene substituted with one or more electron-donating groups attached
directly to the ring and one of more fluoro groups attached to the ring or to the
electron-donating groups wherein said electron-donating groups are selected
from the group consisting of alkyl, alkoxy, hydroxy, and amino (with the proviso
that the compound be liquid).

10

55. An optical switch according to claim 49 wherein said liquid is selected from the group of compounds of Table 2.

15 56. An optical switch according to claim 49 wherein the weight percent
of benzene or substituted benzene in said combination is about 30% to about
90%.

20 ⁵⁷
~~56~~. An optical switch according to claim 49 wherein said benzene of
said combination is substituted with one or more alkyl groups, fluoro groups,
fluoroalkyl groups, or alkoxy groups. wherein said alkyl groups comprise 1 to
about 20 carbon atoms.

25 ⁵⁸
~~57~~. An optical switch according to claim 49 wherein said alkane of said
combination is straight chain, branched chain, or cyclic or a combination thereof
and wherein said alkane is substituted with an hydroxy group, an oxo group, a
keto group, or an alkoxy group and wherein said alkane comprises about 1 to
about 30 carbon atoms.

30 ⁵⁹
~~58~~. An optical switch according to claim 49 wherein said substituted
benzene is selected from the group consisting of toluene, xylene, ethylbenzene,
diethylbenzene, propylbenzene, and dipropylbenzene, and fluorinated
derivatives thereof.

1001082-1
Rule
1.126

60

59. An optical switch according to claim 49 wherein said fluorinated derivatives thereof are selected from the group consisting of fluorobenzene, difluorobenzene, trifluorobenzene, tetrafluorobenzene, pentafluorobenzene, hexafluorobenzene, fluorotoluene, difluorotoluene, trifluoromethyltoluene, tetrafluorotoluene, and pentafluorotoluene.

61

60. An optical switch according to claim 49 wherein said alkane or substituted alkane of said combination is selected from the group consisting of cyclohexane, cyclopentane, hexane, pentane, butane, propane, neopentane, methylbutane, methylpropane, methanol, ethanol, 2-propanol, 1-propanol, 2-butanol, 2-methyl-2-propanol, 2-methyl-1-propanol, acetone, butanone, cyclohexanone and cyclopentanone.

62

61. An optical switch according to claim 49 wherein said substrate comprises silica and said cavity is a groove.

63

62. A method for matching the refractive index of a solid component of a device, said method comprising contacting a solid component of said device with a liquid composition, said liquid composition having a refractive-index that is substantially equal to that of said solid component, said liquid composition being selected from the group consisting of:

- (i) saturated cyclic compounds consisting essentially of carbon and hydrogen and optionally oxygen,
- (ii) benzene substituted with one or more electron-donating groups attached directly to the ring and one of more fluoro groups attached to the ring or to the electron-donating groups, and
- (iii) a combination comprising one or more of benzene or substituted benzene and optionally at least one of an alkane or substituted alkane having a boiling point less than about 130°C.

⁶⁴
~~63~~. A method according to claim 62 wherein said liquid composition is a saturated cyclic compound comprising one or two rings, each have at least four atoms in the ring.

5 ⁶⁵
~~64~~. A method according to claim 62 wherein said liquid composition is benzene substituted with one or more electron-donating groups attached directly to the ring and one or more fluoro groups attached to the ring or to the electron-donating groups wherein said electron-donating groups are selected from the group consisting of alkyl, alkoxy, hydroxy, and amino (with the proviso
10 that the compound be liquid).

⁶⁶
~~65~~. A method according to claim 62 wherein the weight percent of benzene or substituted benzene in said combination is about 30% to about 90%.

15 ⁶⁷
~~66~~. A method according to claim 65 wherein said alkane is substituted with a hydroxy group, an oxo group, a keto group, or an alkoxy group.

⁶⁸
~~67~~. A method according to claim 62 wherein said device is part of an
20 optical system.

⁶⁹
~~68~~. A method for transmitting an optical signal, said method comprising:

- (a) generating an optical signal,
- 25 (b) transmitting said optical signal along a pathway, and
- (c) controlling the direction of said optical signal along said pathway by means of a refractive index-matching liquid that selectively intersects said pathway wherein the refractive index-matching liquid is selected from the group consisting of:
- 30 (i) saturated cyclic compounds consisting essentially of carbon and hydrogen and optionally oxygen,

(ii) benzene substituted with one or more electron-donating groups attached directly to the ring and one of more fluoro groups attached to the ring or to the electron-donating groups, and

(iii) a combination comprising one or more of benzene or substituted benzene and optionally at least one of an alkane or substituted alkane having a boiling point less than about 130°C.

70
69. A method according to claim 68 wherein said liquid composition is a saturated cyclic compound comprising one or two rings, each having at least four atoms in the ring.

71
70. A method according to claim 68 wherein said liquid composition is benzene substituted with one or more electron-donating groups attached directly to the ring and one of more fluoro groups attached to the ring or to the electron-donating groups wherein said electron-donating groups are selected from the group consisting of alkyl, alkoxy, hydroxy, and amino (with the proviso that the compound be liquid).

72
71. A method according to claim 68 wherein the weight percent of benzene or substituted benzene in said combination is about 30% to about 90%.

73
72. A method according to claim 71 wherein said alkane is substituted with an hydroxy group, an oxo group, a keto group, or an alkoxy group.

74
73. A method according to claim 68 wherein said optical device comprises silica.

* * * * *